New technique could dramatically lower costs of DNA sequencing

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Using computer simulations, researchers at the University of Illinois have demonstrated a strategy for sequencing DNA by driving the molecule back and forth through a nanopore capacitor in a semiconductor chip. The technique could lead to a device that would read human genomes quickly and affordably.

Being able to sequence a human genome for $1,000 or less (which is the price most insurance companies are willing to pay) could open a new era in personal medicine, making it possible to precisely diagnose the cause of many diseases and tailor drugs and treatment procedures to the genetic make-up of an individual.

“Despite the tremendous interest in using nanopores for sequencing DNA, it was unclear how, exactly, nanopores could be used to read the DNA sequence,” said U. of I. physics professor Aleksei Aksimentiev. “We now describe one such method.”

Aksimentiev and collaborators describe the method in a paper accepted for publication in the journal *Nano Letters*, and posted on the journal’s Web site.

“Through molecular dynamics simulations, we demonstrate that back-and-forth motion of a DNA molecule in a nanopore capacitor 1 nanometer in diameter produces an electrostatic fingerprint that can be used to read the genetic sequence,” said Aksimentiev, who also is a researcher at the Beckman Institute.

In the researchers' simulations, performed at the university's National Center for Supercomputing Applications, the nanopore capacitor consists of two conducting layers of doped silicon, separated by an insulating layer of silicon dioxide.

As DNA passes through the nanopore, the molecule's electric field induces sequence-specific electrostatic potentials that can be detected at the top and bottom layers of the capacitor membrane.

A semiconductor device capable of reading the electrostatic potentials and decoding the genetic sequence is within the grasp of current technology, Aksimentiev said.

"Nanometer pores in electronic membranes have been manufactured, and the voltage signals resulting from DNA movement through such pores have been recorded." The next big challenge, Aksimentiev said, is to minimize noise in the system, and reduce the speed of DNA molecules moving through the pore.

Source: University of Illinois at Urbana-Champaign